heating said reaction chamber for a sufficient time to provide substantially complete pyrolysis,

said method occurring while maintaining a vacuum in said reaction chamber and yielding reaction products comprising a substantially non-charred and non-oxidized solid residue having minimal unpyrolyzed material, a substantially non-oxidized and polyaromatic hydrocarbon-free liquid hydrocarbon product and a combustible gas.

REMARKS

The Office Action states that the oath or declaration is defective because it does not identify the city and state or foreign country of residence of each inventor. Applicant respectfully submits that the declaration and application data sheet previously submitted contain this information; in fact, this information is found on the official filing receipt that was received from the United States Patent and Trademark Office for this application. A copy of the declaration and application data sheet previously submitted are enclosed with this response.

Rejections Under 35 USC § 112

Claims 1-27 were rejected under 35 USC § 112, second paragraph, as being indefinite for failing to indicate where the vacuum is maintained in the method recited in Claim 1. Claim 1 has been amended to include the language "in said reactor chamber", thus removing any possible ambiguity as to where the vacuum is maintained. Applicant respectfully requests withdrawal of this basis of rejection in view of the above amendment.

Rejections Under 35 USC § 103

The Office Action notes that this application currently names joint inventors. The claims now pending, Claims 1-27, were jointly invented.

Claims 1-26 were rejected under 35 USC § 103(a) as being unpatentable over Gi (4,463,203) in view of either Roy (4,740,270) or Solbakken et al. (4,250,158) when considered with prior art said to be admitted by applicants. Applicants respectfully traverse this basis of rejection.

Gi is cited for allegedly disclosing a pyrolysis process which uses bentonite, and which also contains metals such as magnesium and aluminum. This reference is apparently combined with Solbakken or Roy, said to disclose similar processes under low pressure, to arrive at the present invention. Applicants respectfully disagree with the characterization of the references.

The process of Gi shows many distinctions from the process claimed in the present invention. Gi is trying to overcome a different prior art problem and does not use rubber as a sole material, but uses a mixture of waste materials, and does not disclose the size of the input materials. Further, Gi does not disclose the use of clay as a catalyst; bentonite is described in Gi as an anti-stick agent, and brown coal is used as the catalyst. The "metals" of Gi are bound up in the clay, and do not confer the same chemistry to the pyrolysis reaction as the free metals used in the present invention. Finally, the process of Gi is not carried out in three phases, as recited in the claims of the present invention. Gi uses much higher temperatures than Applicants': at column 1, line 14, a pyrolysis temperature range of 600-700 °C is disclosed, which converts to 1112 -1292°F. The example shows use of even higher temperatures, 700-800°C(col. 4, line 55).

Roy is cited for teaching a low pressure pyrolysis process, but Roy does not teach the use of a clay catalyst in combination with metal dust. Solbakken is also cited for teaching a low pressure pyrolysis process but in fact, Solbakken uses positive pressure of 1-20 psia; 1-20 psia is not a vacuum. The process of Solbakken shows other differences from the method of the present invention. Solbakken heats the waste material to loosen fibers and then separates the pieces before complete pyrolization, and uses temperatures which are generally higher than those used in the present invention.

None of the cited references use a clay catalyst in combination with metal dust in a method of pyrolysis of hydrocarbon material under vacuum conditions, to produce a substantially non-charred and non-oxidized solid residue having minimal unpyrolized material. None of the cited references teach or suggest a method of pyrolysis in which the heating is carried out in at least three phases, to take adavantage of the exothermic nature of the reaction. As can be seen in Figure 3, two heat sources are shown at each end of the reactor chamber. These heat sources can be adjusted independently, to provide minimal fuel input when, during the course of the reaction, less is needed. In a batch process, the fuel input can be adjusted over time (by microprocessor, for example), to take advantage of the energy of the reaction. The text in Gi asserted by the Examiner to show heating in different phases (column 2, lines 30-51), does not teach the use of different heating phases at all, but merely describes at what temperature the various reactions will occur.

Applicants submit that none of the cited references disclose or suggest the a pyrolysis method in which heating occurs in at least three phases, and clay is used in

combination with a metal dust as a catalyst. Therefore, these references simply cannot be combined to provide the missing teachings.

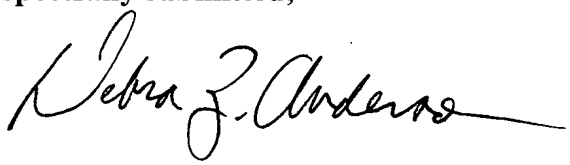
A teaching or suggestion of the claimed combination and a reasonable expectation of success must be found in the prior art references to support a rejection under 35 U.S.C. § 103. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). The mere fact that references can be combined does not render the combination obvious unless the prior art suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). There is no such suggestion in any of the art discussed above, nor does the combination even show all aspects of the present invention. Applicants respectfully request withdrawal of this basis of rejection. Copies of all cases are enclosed.

Claim 27 was rejected under 35 USC § 103(a) as being unpatentable over Gi (4,463,203) in view of either Roy (4,740,270) or Solbakken et al. (4,250,158) in view of Cha et al. (4,983,278). Cha is said to teach the use of tar sands. However, Cha does not provide the other missing teachings, namely use of a metal dust in combination with clay as a catalyst, nor heating in different phases. Applicants submit that Claim 27 is not obvious in view of the cited references and requests withdrawal of this basis of rejection.

SUMMARY

As all outstanding issues have been addressed, Applicants submit that Claims 1-27 are in condition for allowance; such action is respectfully requested at an early date.

Respectfully submitted,



Debra Z. Anderson
Registration No. 44,506
412.566.1910
Attorney for Applicant

APPENDIX

MARKED VERSION TO SHOW CHANGES MADE

Additions are noted by underlining

In the claims:

1. (Amended) A low energy method of pyrolysis of hydrocarbon material comprising:

providing said hydrocarbon material;

loading said hydrocarbon material into a reaction chamber;

adding a clay and metal dust catalyst to said reaction chamber, and

heating said reaction chamber for a sufficient time to provide substantially complete pyrolysis,

said method occurring while maintaining a vacuum in said reaction chamber and yielding reaction products comprising a substantially non-charred and non-oxidized solid residue having minimal unpyrolyzed material, a substantially non-oxidized and polyaromatic hydrocarbon-free liquid hydrocarbon product and a combustible gas.